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VERIFICATION OF TRANSLATION

I, Minoru KUDOH
of a citizen of Japan residing at: 406, 17-15,
Minamiooi 1-chome, Shinagawa-ku, Tokyo 140, Japan
certify that I am familiar with the English and Japanese languages,
and to the best of my knowledge and belief the following is a true
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Patent Application, 2000-243943.

This 10 day of January, 2004

Minoru KUDOH

PATENT OFFICE
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Date of Application: August 11, 2000
Application Number: No. 2000-243943
Applicant(s): NEC Corporation

This 16 day of February, 2001
Kozo OIKAWA
Commissioner,
Patent office

(seal)
Certificate No. 2001-3007652

[Document Name] PATENT APPLICATION
[Identification No.] 76110352
[Filing Date] August 11, 2000
[To] Commissioner; Japanese Patent Office
[International Patent Classification] H05B 33/06
[Inventor]
[Domicile or Residence] c/o NEC Corporation, 7-1, Shiba 5-chome, Minato-ku, Tokyo, Japan
[Name] Takashi ISHIKAWA
[Inventor]
[Domicile or Residence] c/o NEC Corporation, 7-1, Shiba 5-chome, Minato-ku, Tokyo, Japan
[Name] Yuji KONDO
[Applicant]
[ID number] 000004237
[Name] NEC Corporation
[Attorney]
[ID number] 100102864
[Patent Attorney]
[Name or Title] Minoru KUDOH
[Selected Attorney]
[ID number] 100099553
[Patent Attorney]
[Name or Title] Masao OOMURA
[Indication of Charge]
[Deposit Payment Register Number] 053213
[Amount of Fee] 21000
[Items of the Filing Articles]
[Article Name] Specification one copy
[Article Name] Drawings one copy
[Article Name] Abstract one copy
[General Power of Attorney] 9715177
[Proof] Necessary

[Document Name] Specification

[Title of the invention] FLAT PANEL DISPLAY MODULE AND METHOD OF MANUFACTURING THE SAME

[Scope of Patent to be Claimed]

[Claim 1] A flat panel display module comprising:

a transparent substrate with a wiring line terminal section which is formed on one of surfaces of said transparent substrate in at least one of opposing ends of said transparent substrate;

a light emitting section provided in a display region in a center section on said surface on which said wiring line terminal section of said transparent substrate is formed;

a sealing cap provided for a sealing region to cover said light emitting section such that ends of said sealing cap does not reach said ends of said transparent substrate or said wiring line terminal section of said transparent substrate;

a flexible printed circuit board connected to said wiring line terminal section and extending along said sealing cap of said transparent substrate; and

at least one of a semiconductor device mounted on said flexible printed circuit board for said light emitting section.

[Claim 2] The flat panel display module according to claim 1, wherein said semiconductor device is mounted on a side of said flexible printed circuit board of said sealing cap.

[Claims 3] The flat panel display module according to claim 1 or claim 2, wherein said flexible printed circuit board has wiring line patterns for said semiconductor device on both sides at a portion corresponding to said display region at least.

[Claim 4] The flat panel display module according to any of claims 1 to 3, wherein said flexible printed circuit board is provided to extend along said transparent substrate and said sealing cap without being turned back.

[Claim 5] The flat panel display module according to any of claims 1 to 4, wherein said flexible printed circuit board is bent at least twice between said wiring line terminal section and said display region such that said flexible printed circuit board is

approximately parallel to said transparent substrate in said display region.

[Claim 6] The flat panel display module according to claim 5, wherein said flexible printed circuit board is bent to a first direction opposite to said transparent substrate in a first position between said wiring line terminal section of said transparent substrate and said end of said sealing cap,

is bent to said first direction in a second position between said first position and said end of said sealing cap, and

is bent to the second direction opposite to said first direction in a third position between said second position and said end of said sealing cap.

[Claim 7] The flat panel display module according to claim 6, wherein a bending angle in said first position is within 60 degrees.

[Claim 8] The flat panel display module according to claim 6 or claim 7, wherein in said first position, the wiring line pattern of said flexible printed circuit board is formed only on one side.

[Claim 9] The flat panel display module according to any of claims 6 to 8, wherein in said second position, said wiring line pattern of said flexible printed circuit board is formed on both sides and a resist film is applied.

[Claim 10] The flat panel display module according to any of claims 6 to 9, wherein a bending angle of said second position is within 90 degrees and a summation of the bending angle in said first position and the bending angle in said second position is equal to or less than 90 degrees.

[Claim 11] The flat panel display module according to any of claims 6 to 10, wherein said flexible printed circuit board is bent to said second direction approximately being parallel to said transparent substrate in said third position.

[Claim 12] The flat panel display module according to any of claim s6 to 10, wherein a metal film is formed on a back side of said flexible printed circuit board in one or both of said second position and said third position.

[Claim 13] The flat panel display module according to claim 6,

wherein said flexible printed circuit board is bent to said first direction opposite to said transparent substrate in a fourth position between said end of said sealing cap and said end of said light emitting section, and

is bent to said second direction opposite to said first direction in a fifth position between said fourth position and said end of said light emitting section.

[Claim 14] The flat panel display module according to claim 13, wherein in said fourth position, said wiring line patterns of said flexible printed circuit board are formed on both sides of said flexible printed circuit board and a resist film is applied.

[Claim 15] The flat panel display module according to claim 13 or 14, wherein said flexible printed circuit board is bent to said second direction approximately being parallel to said transparent substrate in said fifth position.

[Claim 16] The flat panel display module according to any of claims 1 to 15, further comprising a frame provided along said end of said transparent substrate.

[Claim 17] The flat panel display module according to claim 16, wherein said frame sandwiches and supports said flexible printed circuit board together with said end of said sealing cap.

[Claim 18] The flat panel display module according to any of claims 1 to 17, wherein said wiring line terminal section is formed on both of said surface of said opposite ends of said transparent substrate, and

said flexible printed circuit board is connected with said both of said wiring line terminal sections.

[Claim 19] The flat panel display module according to any of claims 1 to 17, wherein said wiring line terminal section is formed on both of said surface of said opposite ends of said transparent substrate, and

said flexible printed circuit board is connected with said both of said wiring line terminal sections.

[Claim 20] The flat panel display module according to any of claims 1 to 19, wherein said light emitting section is an organic EL film.

[Claim 21] The flat panel display module according to any of claims 1 to 20, wherein said light emitting section is an organic EL film,

the flat panel display module further comprises a desiccant section between said light emitting section and said sealing cap in a center section of said display region, in which said sealing cap has a protrusion section corresponding to said desiccant section, and

said semiconductor devices are plural which is provided on said flexible printed circuit board on a side of said transparent substrate between said protrusion section of said sealing cap and said end of said sealing cap.

[Claim 22] A manufacturing method of a flat panel display module, comprising the steps of:

forming a display section, wherein said display section comprises; a transparent substrate having a wiring line terminal section which is formed on one of surfaces of said transparent substrate in at least one of opposing ends of said transparent substrate; a light emitting section provided in a display region in a center section on said surface on which the said wiring line terminal section of said transparent substrate is formed; a sealing cap provided for a sealing region to cover said light emitting section such that ends of said sealing cap does not reach said ends of said transparent substrate or said wiring line terminal section of said transparent substrate;

connecting a flexible printed circuit board on which semiconductor devices mounted to said wiring line terminal section of said transparent substrate;

fixing a frame around said ends of said transparent substrate of said display section.

[Claim 23] The manufacturing method of a flat panel display module according to claim 22, wherein said step of connecting said flexible printed circuit board comprises the steps of:

forming said flexible printed circuit board; and

mounting said semiconductor devices on said flexible printed circuit board.

[Claim 24] The manufacturing method of a flat panel display module according to claim 22, wherein said step of connecting said flexible printed circuit board comprises the steps of:

mounting said semiconductor devices on said flexible printed circuit board; and forming said flexible printed circuit board.

[Claim 25] The manufacturing method of a flat panel display module according to claim 23 or 24, wherein said forming step of said flexible printed circuit board comprises the steps of:

bending said flexible printed circuit board to a first direction opposite to said transparent substrate in a first position between said end of said sealing cap of and said wiring line terminal section of said transparent substrate;

bending said flexible printed circuit board to said first direction in a second position between said first position and said end of said sealing cap; and

bending said flexible printed circuit board to a second direction opposite to said first direction in a third position between said second position and said end of said sealing cap.

[Claim 26] The manufacturing method of a flat panel display module according to claim 25, wherein a bending angle in said first position is equal to or less than 60 degrees,

a bending angle in said second position is equal to or less than 90 degrees, and

a summation of said bending angle in said first position and said bending angle in said second position is equal to or less than 90 degrees.

[Claim 27] The manufacturing method of a flat panel display module according to claim 25 or 26, wherein said forming step of flexible printed circuit board comprises the steps of:

bending said flexible printed circuit board to said first direction opposite to said transparent substrate in a fourth position between said end of said sealing cap and an end of said light emitting section; and

bending said flexible printed circuit board to said second direction opposite to the said first direction in a fifth

position between said fourth position and the end of said light emitting section.

[Detailed Description of the Invention]

[0001]

[Technical Field to which the Invention belongs]

The present invention relates to a flat panel display module and a manufacturing method, and more specifically to a flat panel display module which is made thin and small and a manufacturing method of the same.

[0002]

[Conventional Technique]

As a flat panel display unit used in an electronic unit like a mobile phone which is portable and small, flat panel display units such as an LCD and an organic EL display are known. Because the module of such a flat panel display unit is incorporated into the portable and small electronic equipment, the module is desired to be small and light.

[0003]

Here, a conventional technique about the flat panel display module is disclosed in Japanese Laid Open Utility Model Application (JU-A-Heisei 1-161597). In this conventional technique, a flat panel display module is composed of a transparent substrate (1), a circuit board (18), many external lead connection terminal sections (23), and a the flexible lead (15). The transparent substrate (1) and the circuit board (18) are arranged in a laminate layer and the thickness of the module becomes thick. The flexible lead (15) is connected with the terminal sections (23) of the transparent substrate (1) and is connected with the circuit board (18). Therefore, the flexible lead (15) is connected to be turned back. Here, the effective connectable length of the terminal section is equal to or more than twice the connection length of the terminal section of the flexible lead (15).

[0004]

Also, a thin film EL display unit is disclosed in the Japanese Laid Open Patent application (JP-A-Heisei 2-227989). In

this conventional technique, like the above-mentioned conventional technique, an organic EL panel (10) and a printed circuit board (30) are arranged in a laminate layer.

The flexible printed circuit board (40) turns back twice after connection with the organic EL panel (10) and is connected with the printed circuit board (30), and moreover, is turned back and is connected with the back of printed circuit board (30). In this conventional technique, there is a possibility that the wiring lines of the flexible printed circuit board (40) are broken. Also, in this structure, it is not possible to decrease the thickness of the film EL display unit.

[0005]

Also, the connection structure of a flat display is disclosed in the Japanese Laid Open Patent application (JP-A-Heisei 6-230728). In this conventional technique, the flat display is composed of a flat display panel (1), a drive board (3), one side flexible printed circuit board (14) and a connection cable (17). The one side flexible printed circuit board (14) is provided with the printed circuits with a driver IC (6). The connection cable (17) is connected with the drive board (3), and is turned back twice and is connected with the one end of the one side flexible printed circuit board (14). The one side the flexible printed circuit board (14) connected with the connection cable (17) is connected with the driver IC (6) apart from the drive board (3) into a lateral direction. In this way, the connection cable (17) is bent like the character of S and is possibly broken. Also, because the driver IC (6) is apart from the drive board (3), the size in the lateral direction cannot be made small.

[0006]

Also, an organic EL display is disclosed in Japanese Laid Open Patent Application (2000-3140). In this conventional technique, an organic EL display is composed of a substrate (1), an organic EL structure, a sealing plate (2) and a wiring line structure (3). The sealing plate (2) seals an organic EL structure. A circuit to drive or control an organic EL structure is prepared

onto the superficies of the sealing plate (2).

The wiring line structure (3) connects the circuit, which is formed on substrate (1), and the circuit of sealing plate (2). This wiring line structure (3) is arranged in the position where sealing plate (2) on substrate (1) is not arranged. Moreover, the wiring line structure (3) has a circuit on an externally orientated surface. In this example, the wiring line structure (3) is composed of some portions and some process to connect them is necessary. Also, the wiring line structure (3) and the sealing plate (2) are connected with the bonding wires. Therefore, the manufacturing method of the organic EL display takes large cost and time. Also, because the sealing plate (2) and the wiring line structure (3) are used, it is not possible to reduce the thickness of the organic EL display.

[0007]

Also, a display unit is disclosed in Japanese Patent No. 2612968. In this conventional technique, a flexible printed circuit board is bent to be turned back from a support plate to a hard printed circuit board. Therefore, there is a possibility that a wiring is broken. Also, a display panel drive circuit is set in the hard printed circuit board, and the hard printed circuit board is provided externally from the support plate, in which a display panel is formed, to a lateral direction. Therefore, there is a problem that the size of the lateral direction has become large compared with the display size of the display panel.

[0008]

[Problems the Invention Tries to Solve]

Therefore, an object of the present invention is to provide a flat panel display module which is possible to be small and thin.

[0009]

Another purpose of the present invention is to provide a manufacturing method of a flat panel display module, in which the number of steps can be reduced and also a process is easy so as to be possible to reduce costs.

[0010]

Another purpose of the present invention is to provide a flat panel display module and a manufacturing method, in which a flexible printed circuit board is connected without being turned back.

[0011]

Another purpose of the present invention is to provide a flat panel display module and a manufacturing method, in which break of a wiring line in a flexible printed circuit board can be prevented.

[0012]

Another purpose of the present invention is to provide a flat panel display module and a manufacturing method, in which a flexible printed circuit board can be connected to a wiring line connection sections at both opposite ends.

[0013]

Another purpose of the present invention is to provide a flat panel display module and a manufacturing method, in which it is possible to surely connect the flexible printed circuit board to very short terminals.

[0014]

Another purpose of the present invention is to provide a flat panel display module and a manufacturing method, wherein a connection of the flexible printed circuit board is supported.

[0015]

Another purpose of the present invention is to provide a flat panel display module and a manufacturing method in which it is possible to apply to an organic EL unit.

[0016]

[Means for Solving the Problems]

A means for solving the problems will be described bellow. The technical terms in the following description of the embodiment have numbers and symbols and so on with parentheses "( )". Though, the numbers and symbols is only used to clarify the correspondence between the description of Claims and Embodiment, and they should not be used to interpret the Claims.

[0017]

In the first aspect of the present invention, A flat panel display module comprising a transparent substrate (11) with a wiring line terminal section (22,23) which is formed on one of surfaces of the transparent substrate (11) in at least one of opposing ends of the transparent substrate, a light emitting section (12) provided in a display region in a center section on the surface on which the wiring line terminal section (22,23) of the transparent substrate (11) is formed, a sealing cap (13) provided for a sealing region to cover the light emitting section (12) such that ends of the sealing cap (13)does not reach the ends of the transparent substrate or the wiring line terminal section (22,23) of the transparent substrate (11), a flexible printed circuit board(15) connected to the wiring line terminal section (22, 23) and extending along the transparent substrate(11) and the sealing cap (13) of the transparent substrate, and at least one of a semiconductor device(18) mounted on the flexible printed circuit board (15)for the light emitting section (12).

[0018]

Here, it is desirable that the semiconductor device (18) is mounted on a side of the sealing cap (13) of the flexible printed circuit board (15). Therefore, it is possible that the flat panel display module can be thin.

[0019]

Also, it is desirable that the flexible printed circuit board (15) has wiring line patterns for the semiconductor device (18) on both sides at a portion corresponding to the display region at least. It is also desirable that the flexible printed circuit board (15) is provided to extend along the transparent substrate (11) and the sealing cap (13) without being turned back.

[0020]

Further also, the flexible printed circuit board (15) may be bent at least twice between the wiring line terminal section (22,23) and the display region such that the flexible printed circuit board (15) is approximately parallel to the transparent substrate (15) in the display region.

[0021]

For Example, the flexible printed circuit board (15) may be bent to a first direction opposite to the transparent substrate (11) in a first position (51) between the wiring line terminal section (22,23) of the transparent substrate (11) and the end of the sealing cap (13),

be bent to the first direction in a second position (52) between the first position (51) and the end of the sealing cap, and

be bent to the second direction opposite to the first direction in a third position (53) between the second position (52) and the end of the sealing cap.

In this case, it is desirable that a bending angle in the first position (51) is within 60 degrees. Also, it is desirable that the wiring line pattern of the flexible printed circuit board is formed only on one side from the aspect of prevention of wiring line breaking.

[0022]

In the second position (52), it is desirable that the wiring line pattern of the flexible printed circuit board (15) is formed on both sides and a resist film is applied. In this time, it is further desirable that a bending angle in the second position (52) is within 90 degrees and a summation of the bending angle in the first position (51) and the bending angle in the second position (52) is equal to or less than 90 degrees.

In this case, the flexible printed circuit board (15) is bent to the second direction approximately being parallel to the transparent substrate (11) in the third position (53). Also, it is desirable that a metal film is formed on a backside of the flexible printed circuit board (15) in one or both of the second position and the third position.

[0023]

Furthermore, the flexible printed circuit board (15) may be bent to the first direction opposite to the transparent substrate (11) in a fourth position (54) between the end of the sealing cap and the end of the light emitting section (12), and is bent to the second direction opposite to the first direction in a fifth position (55) between the fourth position the end of the

light emitting section (12). Also, in the fourth position, it is desirable that the wiring line patterns of the flexible printed circuit board (15) are formed on both sides of the flexible printed circuit board (15) and a resist film is applied. Further, the flexible printed circuit board (15) may be bent to the second direction approximately being parallel to the transparent substrate in the fifth position (55).

[0024]

Here, the flat panel display module may further comprise frame (16) provided along the end of the transparent substrate. In this case, it is desirable that the frame sandwiches and supports the flexible printed circuit board (15) together with the end of the sealing cap (13).

[0025]

The wiring line terminal section (22,23) is formed on both of the surface of the opposite ends of the transparent substrate (11), and the flexible printed circuit board (15) is connected with the both of the wiring line terminal sections. Otherwise, it is desirable that the wiring line terminal section (22) is formed on one side of the surface of the opposite ends of the transparent substrate (11), and the flexible printed circuit board is connected with one side of the wiring line terminal section (22).

[0026]

In above mentioned flat panel display module, the light emitting section (12) may be an organic EL film. In this case, the flat panel display module further comprises a desiccant section (17) between the light emitting section (12) and the sealing cap (13) in a center section of the display region. It is desirable that when the sealing cap (13) has a protrusion section corresponding to the desiccant section (17), a plurality of semiconductor devices (18) are provided on the flexible printed circuit board (15) on a side of the transparent substrate (11) between the protrusion section of the sealing cap (13) and the end of the sealing cap (13).

[0027]

In the other aspect of the present invention, a manufacturing method of a flat panel display module is achieved by steps of: forming a display section, wherein the display section comprises; a transparent substrate (11) having a wiring line terminal section (22,23) which is formed on one of surfaces of the transparent substrate (11) in at least one of opposing ends of the transparent substrate; a light emitting section (12) provided in a display region in a center section on the surface on which the wiring line terminal section (22,23) of the transparent substrate (11) is formed; a sealing cap (13) provided for a sealing region to cover the light emitting section (12) such that ends of the sealing cap (13) does not reach the ends of the transparent substrate (11) or the wiring line terminal section (22,23) of the transparent substrate (11), connecting a flexible printed circuit board (15) on which semiconductor devices (18) mounted to the wiring line terminal section (22,23) of the transparent substrate (11), fixing a frame (16) around the ends of the transparent substrate (11) of the display section.

[0028]

In this case, the step of connecting the flexible printed circuit board (15) is achieved by forming the flexible printed circuit board and mounting the semiconductor devices (18) on the formed flexible printed circuit board. Also, he step of connecting the flexible printed circuit board (15) may be achieved by mounting the semiconductor devices (18) on the flexible printed circuit board and forming the flexible printed circuit board (15).

[0029]

The step of forming the flexible printed circuit board (15) may be achieved by bending the flexible printed circuit board (15) to a first direction opposite to the transparent substrate (11) in a first position (51) between the end of the sealing cap and the wiring line terminal section (22,23) of the transparent substrate (11), by bending the flexible printed circuit board (15) to the first direction in a second position (52) between the first position (51) and the end of the sealing cap (13), and by bending the flexible printed circuit board (15) to a second direction

opposite to the first direction in a third position (53) between the second position (52) the end of the sealing cap (13).

[0030]

Here, it is desirable that a bending angle in the first position (51) is equal to or less than 60 degrees, a bending angle in the second position (52) is equal to or less than 90 degrees, and a summation of the bending angle in the first position (51) and the bending angle in the second position is equal to or less than 90 degrees.

Also, forming the flexible printed circuit board (15) may be achieved by bending the flexible printed circuit board (15) to the first direction opposite to the transparent substrate (11) in a fourth position (54) between the end of the sealing cap (13) and an end of the light emitting section (12) and by bending the flexible printed circuit board (15) to the second direction opposite to the first direction in a fifth position (55) between the fourth position (54) and the end of the light emitting section (12).

[0031]

[Embodiments of the Invention]

Hereinafter, a flat panel display module of the present invention will be described with reference to the attached drawings. Here, in the flat panel display module 1 of the present invention, an organic EL (electro-luminescence) device is used to as a display device. However, the display device is not limited to the organic EL device.

[0032]

Fig. 1 is a plan view of the flat panel display module according to the first embodiment of the present invention from the side of the back. Fig. 2 is a diagram showing a display section used in the flat panel display module 1 shown in Fig. 1. Fig. 3 is a cross sectional view of the flat panel display module shown in Fig. 1 in the longitudinal direction.

[0033]

Referring to Fig. 1, Fig. 2 and Fig. 3, the flat panel display module 1 of the present invention is composed of the

display section, a flexible printed circuit board 15 and a frame 16. The display section is composed of a transparent substrate 11, a display section 12, a sealing cap 13.

[0034]

Referring to Fig. 1, the flat panel display module 1 according to the first embodiment of the present invention has an approximately rectangular shape, and the wiring line section for connection to an external unit extends from the center of one of long sides. A display region is provided in the region within the sealing cap at the display section and a plurality of semiconductor devices 18 are arranged around the convex section at a the desiccant section in the center of the sealing cap. These semiconductor devices are provided to process the signals inputted from the wiring line section for the external connection and to drive the display section.

[0035]

In Fig. 1, one chain line gives an outline of the bent positions when the flexible printed circuit board 15 is bent.

[0036]

The transparent substrate 11 is composed of such a transparent member as a glass plate. The shape of the transparent substrate 11 is a rectangle substantively in this example. However, the shape is not limited to it. Referring to Fig. 2, the lower surface section of the transparent substrate 11 has three of the wiring line terminal sections 21, 22 and 23, and has a display region 41.

[0037]

The terminal region 21 is provided for an end of the long side section which is opposite to the wiring line section for the external connection in the lower side of the transparent substrate 11. The wiring line terminal sections 22 and 23 are provided for ends of the two shorter side sections of the transparent substrate 11 respectively. The display region 41 is provided in the central section on the lower side section of the transparent substrate 11. In this example, the shape of the display region 41 is a rectangle substantively. The display section is driven in a matrix manner

by drive signals supplied to the wiring line terminal sections 21, 22 and 23 from the semiconductor device. In this way, a desired image is displayed and an image can be seen through the transparent substrate 11.

[0038]

Fig. 3 shows the structure of the lower side section of the transparent substrate 11. Referring to Fig. 3, a light emitting section 12 is composed of an organic EL device in this example. The emitting light section 12 is formed in the display region 41 of the transparent substrate 11 to have a predetermined thickness. The organic EL device is driven by the semiconductor device 18 and emits light. To protect the organic EL device against moisture, the desiccant section 17 is generally provided onto the organic EL device.

[0039]

A sealing cap 13 is formed on the lower side section of the transparent substrate 11 to cover the light emitting section 12 and the desiccant section 17, and also to cover the transparent substrate 11 around the light emitting section 12. However, the ends of the sealing cap 13 do not reach the ends of the transparent substrate 11. The plane shape of the sealing cap 13 is a rectangle approximately in this example. Also, the sealing cap 13 has an approximately uniformed thickness.

[0040]

The sealing cap 13 has a first convex section below. The shape of this first convex section corresponds to the shape of the display region 41 and is larger than the shape of the display region 24. Also, the sealing cap 13 has the second convex section which protrudes from the first convex section far below. The shape of this second convex section corresponds to the desiccant section 17 and has the shape which is rather larger than the desiccant section 17. When the desiccant section 17 is unnecessary, of course, the second convex section does not exist. The plane of the lower side section of the first convex section and the plane of the lower side section of the second convex section in the sealing cap 13 are parallel to the plane of the transparent

substrate 11 approximately.

[0041]

The semiconductor devices 18 are mounted on the flexible printed circuit board 15. The semiconductor devices 18 are composed of a signal generating circuit to generate drive signals based on the input signal from the wiring line section for the external connection and a drive circuit to drive the light emitting section 12 based on the drive signals. However, depending on the circuit structure, only the drive circuit is needed.

[0042]

Referring to Fig. 1, the shape of the flexible printed circuit board 15 is rectangular approximately. However, the wiring line section for the external the wiring lines extend from the center section of the one of the long side.

The wiring line terminal section 31 composed of the terminals which is connected to the terminal set on the wiring line terminal section 21 of the transparent substrate 11. The wiring line terminal section 31 is provided for the other end of the long side of the flexible printed circuit board 15. Also, the wiring line terminal sections 32 and 33 which composed of the terminals connected with the terminals set on the wiring line terminal sections 22 and 23 of the transparent substrate 11 are provided for the ends of the two shorter sides where the flexible printed circuit board 15 is opposite.

[0043]

Also, in the flexible printed circuit board 15, a cut-out portion is formed in each of the corner sections between the long side sections and the shorter side sections. These cut-out portions are provided not to give influence to the long side section or the shorter side section when the long side section or shorter side section of the flexible printed circuit board 15 is bent.

[0044]

The flexible printed circuit board 15 is connected with the wiring line terminal sections 21, 22 and 23 of the transparent substrate 11 at the wiring line terminal sections 31, 32 and 33.

At this time, a wiring line terminal section is pressed and connected at the A section. In this way, the flexible printed circuit board 15 is arranged along the outer surface of the sealing cap 13 without being bent to be turned back.

[0045]

Also, the upper surface section of the flexible printed circuit board 15 has a first region opposite to the lower side section of the first convex section of the sealing cap 13 and a second region opposite to the lower side section of the second convex section of the sealing cap 13, when the flat panel display module is formed.

The first region corresponds to the display region and is located in the center section of the surface section of the flexible printed circuit board 15. Also, the second region corresponds to the desiccant section 17 and is in the center of the first region.

[0046]

Also, the plurality of semiconductor devices 18 are provided in the first region in the surface section of the flexible printed circuit board 15 except the second region to drive the light emitting section 12. These semiconductor devices are connected each other in the wiring line pattern which is formed on the both sides of the flexible printed circuit board 15. Here, a resist film is applied onto the wiring line pattern.

[0047]

A drive circuit element in these semiconductor devices 18 is connected with the terminals of the wiring line terminal sections 31, 32 and 33 which were formed on the surface section of the flexible printed circuit board 15. The terminals in the wiring line terminal sections 31, 32 and 33, and the terminals in the wiring line terminal sections 21, 22 and 23 formed on the lower side section of the transparent substrate 11 are pressed and connected. Then these circuits allow to the drive signals to be supplied to the light emitting section 12.

[0048]

Next, the connection of the flexible printed circuit

board 15 to the transparent substrate 11 will be described below.

[0049]

The length of each terminal in the wiring line terminal sections 21, 22 and 23 of the transparent substrate 11 is as very short as about 1.8 mm. Also, the pitch between the terminals is 0.088 mm in the wiring line terminal section 21 and is 0.272 mm in the wiring line terminal sections 22 and 23. The sealing cap 13 is formed to a near portion of the wiring line terminal sections 21, 22 and 23.

[0050]

Fig. 4 is an expanded drawing of the connection section of the flexible printed circuit board 15 to the transparent substrate 11. Referring to Fig. 4, the wiring line patterns are basically printed on the both sides in the flexible printed circuit board. An insulating resist is applied onto the wiring line pattern. However, the wiring line pattern is formed only at the one side in the wiring line terminal section 31 on the long side of the flexible printed circuit board 15 and the wiring line terminal sections 32 and 33 on the shorter side, and a resist is not applied.

[0051]

The length of the terminal of the wiring line terminal sections 31, 32 and 33 is equal to or less than 1.8 mm, as described above. In this example, the flexible printed circuit board 15 is bent to the first direction so as to leave the transparent substrate 11 at the first position 51 apart from the end by 1 mm. Therefore, the length for the flexible printed circuit board 15 to be pressed and connected to the transparent substrate 11 is about 1 mm and it is very narrow. It is easy for the flexible printed circuit board 15 to be peeled off from the transparent substrate 11. If the flexible printed circuit board 15 is turned back as in the conventional example, the unnecessary force acts on the connection point A so that the flexible printed circuit board 15 has been easily peeled off the transparent substrate 11.

[0052]

In the first position 51, the flexible printed circuit board 15 is further bent to the first direction at the angle within 60 degrees. In the first position 51, as described above, the wiring line pattern is formed only at the one side and any resist layer is not applied. Therefore, when the flexible printed circuit board 15 is bent to the too large angle at a time, there is possibility that the wiring line is broken. Therefore, it is desirable that the bend angle is equal to or less than 60 degrees. In this example, the flexible printed circuit board 15 is bent by the 30 degrees.

[0053]

Next, the flexible printed circuit board 15 is further bent to the first direction in the second position 52 between the first position 51 and the sealing cap 13. In this position, the flexible printed circuit board may have the wiring line patterns at the both sides and may have the wiring line pattern at the one side. In any case, a resist layer is applied onto the wiring line pattern. The bending angle in the second position 52 is within 90 degrees.

Because the resist layer is applied to this position, the wiring line is never broken even if the flexible printed circuit board 15 is supposed to have been bent at the larger angle. Also, it should be avoided that the flexible printed circuit board 15 is bent to turn back, not to unnecessary force acts on the connection section of the wiring line terminal section, as described above. Therefore, the bending angle in the second position 52 is desirably within 90 degrees. Also, it is desirable that a summation of the bending angle in the first position 51 and the bending angle in the second position 52 do not exceed 90 degrees. In this example, the bending angle in the second position 52 is about 60 degrees.

[0054]

The flexible printed circuit board 15 is bent to the direction which is approximately parallel to the transparent substrate 11 in a third position 53 with the height which is approximately equal to the thickness of the sealing cap 13. It

should be noted that the resist layer is applied to the flexible printed circuit board 15 on the side of the center in the display region from the second position 52.

Here, It is desirable that the flexible printed circuit board has a metal film on the back plane side in one or both of the second position and the third position so as to the plastic deformation property is increased at the bending position. The back plane side of the flexible printed circuit board means a plane in which the wiring line pattern is not formed. Also, it is desirable that the metal film is formed on the whole back plane. The wiring line pattern is a metal film but separated from the metal film.

[0055]

The flexible printed circuit board 15 is bent to the first direction in a fourth position 54 between the end of the sealing cap 13 and the end of the light emitting section 12. Moreover, the flexible printed circuit board 15 is bent to be parallel to the transparent substrate 11 in a fifth position 55 corresponding to the maximum height of the sealing cap 13.

[0056]

The process of bending (forming) as described above is carried out respectively on the side of the long side and the shorter side in the flexible printed circuit board 15. In this way, the flexible printed circuit board 15 is arranged along the outer surface of the sealing cap 13 from one of the shorter sides to the other thereof in one of the surfaces of the transparent substrate 11 without being bent to be turned back. At this time, the space where it is possible for the semiconductor devices 18 to be installed is secured in the region between the fourth position 54 and the display region.

[0057]

After the flexible printed circuit board 15 is arranged, the frame 16 is arranged along the ends of the transparent substrate 11. The frame 16 has a section of the character "L" and the bottom section extends to the display region. If the upper surface of the bottom section has a contact with the sealing cap

13 in the B section between the third position 53 and the fourth position 54, the flexible printed circuit board 15 can be sandwiched and supported by the frame 16 and the sealing cap 13 in the B section. Therefore, it is possible to prevent that unnecessary force acts on the connection section in the wiring line terminal sections 31, 32 and 33. In this case, even if the total bending angle including the bending angle in the second position 52 gets to be near 90 degrees or exceeds 90 degrees a little, there is little occasion that the wiring line terminal sections 31, 32 and 33 peel off the wiring line terminal sections 21, 22 and 23 of the transparent substrate 11.

[0058]

At this time, depending on the processing precision, there is a case that the flexible printed circuit board 15 cannot be sandwiched or supported by the sealing cap 13 and the frame 16. In such a case, an insulating filling film may be inserted between the sealing cap 13 and the frame 16.

[0059]

Next, the method of manufacturing a flat panel display module of the present invention will be described below.

[0060]

First, the light emitting section 12 is formed on the transparent substrate 11, and the light emitting section 12 is sealed by the sealing cap 13 so as to be prepared the display section. Next, the formed flexible printed circuit board 15 as described above is prepared. The semiconductor devices are mounted on predetermined positions of the flexible printed circuit board 15. The flexible printed circuit board 15 is pressed and connected on the wiring line terminal sections 21, 22 and 33 of the transparent substrate 11 in the wiring line terminal sections 31, 32 and 33. After that, the frame 16 is installed to the transparent substrate 11. At this time, it is desirable to sandwich and support the flexible printed circuit board 15 by the sealing cap 13 and the frame 16 as described above. In this way, the flat panel display module is completed.

[0061]

It should be noted that the flexible printed circuit board 15 may be bent before the semiconductor devices 18 are mounted thereon or after the semiconductor devices 18 are mounted thereon.

[0062]

Next, the flat panel display module in the second embodiment of the present invention will be described. Fig. 5 is a cross section view of the flat panel display module in the second embodiment of the present invention.

[0063]

Referring to Fig. 5, in the second embodiment, the forming shape of the flexible printed circuit board 15 is same as the first embodiment. However, the flexible printed circuit board 15 has the wiring line terminal sections 31 and 32, but it does not have the wiring line terminal section 33. The semiconductor devices are arranged in the sealing region on the side of the wiring line terminal section 32 and the sealing region on the side of the wiring line terminal section 33. Here, the sealing region is the region corresponding to the first convex section of the sealing cap 13 except the second convex section. On the shorter side of the flexible printed circuit board 15, the flexible printed circuit board 15 is supported by the sealing cap 13 in the sealing region and the frame 16.

[0064]

Next, the flat panel display module in the third embodiment of the present invention will be described. Fig. 6 is a cross sectional view of the flat panel display module in the third embodiment of the present invention.

[0065]

Referring to Fig. 6, in the third embodiment, the flexible printed circuit board 15 has the wiring line terminal sections 31 and 32 but does not have the wiring line terminal section 33. Also, the semiconductor devices are arranged only in the sealing region on the side of the wiring line terminal section 32. On the side of the long side of the flexible printed circuit board 15, the bent shape of the flexible printed circuit board is

same as the first embodiment. Therefore, the flexible printed circuit board 15 is supported by the sealing cap 13 in the display region and the frame 16.

[0066]

Also, on the side of the wiring line terminal section 32 of the flexible printed circuit board 15, the forming shape of the flexible printed circuit board is same as the first embodiment. Therefore, the flexible printed circuit board 15 is supported by the sealing cap 13 in the display region and the frame 16. However, the flexible printed circuit board 15 is formed to extend along the second convex section and the first convex section of the sealing cap 13 on the side of the shorter side corresponding to the wiring line terminal section 32. Also, the flexible printed circuit board 15 is sandwiched and supported in the C section by a section corresponding to the display region of the sealing cap 13 and the frame 16.

[0067]

Next, the flat panel display module in the fourth embodiment of the present invention will be described. Fig. 7 is a cross sectional view of the flat panel display module in the fourth embodiment of the present invention.

[0068]

Referring to Fig. 7, in the fourth embodiment, the bending process is not carried out to the flexible printed circuit board 15 in the fourth and the fifth position. Also, the height of the third position from the transparent substrate 11 is set to be equal to the height of the fifth position. Therefore, the flexible printed circuit board 15 is never sandwiched and supported by the frame 16 and the sealing cap 13. Therefore, force acts directly on the connection section, but there is a merit that the semiconductor device mounting section can be widely used.

[0069]

[Effect of the invention]

As mentioned above, according to the flat panel display module of the present invention, the flexible printed circuit board is connected to the connection terminal section of the

transparent substrate without being turned back. Therefore, there is no possibility that unnecessary force acts on the connection section so that the flexible printed circuit board is peeled off the transparent substrate. Also, even if the width of the connection section is narrow, it is difficult for unnecessary force to act, because the flexible printed circuit board is arranged along the connection section. Therefore, the flexible printed circuit board is bent to have a small angle at first, and is next bent to have the larger angle.

[0070]

In case of this bending process, the wiring line pattern is never broken because the bending angle is small in the first bending section. Also, there is no possibility that the wiring line pattern is broken because that wiring line pattern is protected by the resist layer in this section although the bend angle is large in the next bending section.

[0071]

Also, because the flexible printed circuit board is sandwiched and supported by the frame and the sealing cap, it is difficult for the force to act on the connection section.

[0072]

Also, the semiconductor device to drive the light emitting section such as the organic EL device is provided for the free space from the sealing cap for protecting the light emitting section on the side of the light emitting section of the flexible printed circuit board. Therefore, the semiconductor device never protrudes and the flat panel display module can be made thin.

[0073]

In this way, according to the present invention, the flat panel display module can be made small and thin. Moreover, as mentioned above, the flexible printed circuit board is previously formed to prevent break of the wiring line pattern in the bending process. Thus, it is possible to provide the flat panel display module which has sure connection in a small number of steps.

[Brief Description of the drawings]

[Fig. 1]

Fig. 1 is a back plan view showing the plane structure of a flat panel display module according to a first embodiment of the present invention.

[Fig. 2]

Fig. 2 is a plan view showing a display section used in the flat panel display module according to the first embodiment of the present invention.

[Fig. 3]

Fig. 3 is a cross sectional view showing a section along the long side of the flat panel display module according to the first embodiment of the present invention.

[Fig. 4]

Fig. 4 is an expanded view showing a connection section of the flat panel display module according to the first embodiment of the present invention.

[Fig. 5]

Fig. 5 is a cross sectional view showing a section along the long side of the flat panel display module according to a second embodiment of the present invention.

[Fig. 6]

Fig. 6 is a cross sectional view showing a section along the long side of the flat panel display module according to a third embodiment of the present invention.

[Fig. 7]

Fig. 7 is an expanded cross sectional view showing a connection section of the flat panel display module according to a fourth embodiment of the present invention.

[Description of the reference Numerals and Symbols]

11 transparent substrate
12 light emitting section
13 sealing cap
15 flexible printed circuit board
16 frame
17 desiccant section
18 semiconductor devices
41 display region

[Document Name] Abstract

[Abstract]

[Object] To provide a flat panel display module which is possible to be small and thin and provide a manufacturing method of the same.

[Solving Means] A flat panel display module comprises a transparent substrate (11) with a wiring line terminal section (22,23) which is formed on one of surfaces of the transparent substrate (11) in opposing ends of the transparent substrate, a light emitting section (12) provided in a display region in a center section on the surface on which the wiring line terminal section (22,23) of the transparent substrate (11) is formed, a sealing cap (13) provided for a sealing region to cover the light emitting section (12), a flexible printed circuit board (15) connected to the wiring line terminal section (22, 23) and extending along the transparent substrate(11) and the sealing cap (13), and at least one of a semiconductor device (18) mounted on the flexible printed circuit board (15) for the light emitting section (12).

[Selected Drawing] Fig.1

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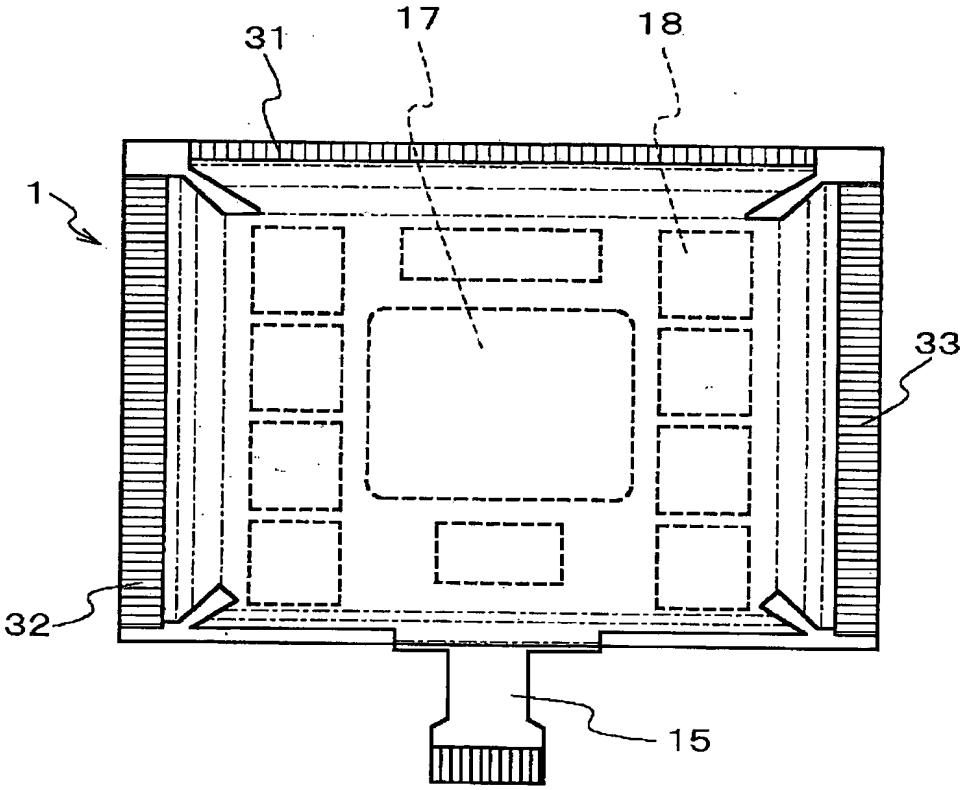
提出日 平成１２年 ８月１１日

整理番号＝７６１１０３５２ 特願2000-243943 頁: 1/ 5

【書類名】 図面 [DOCUMENT NAME] DRAWINGS

【図１】 [FIG.1]



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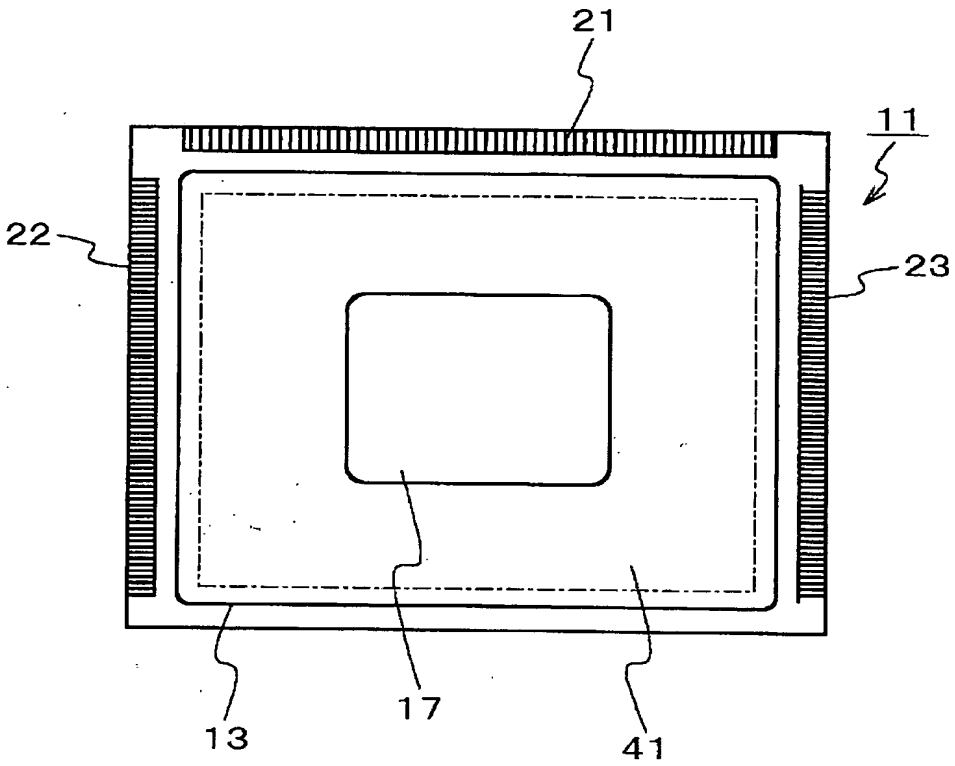
【図２】 [FIG.2]



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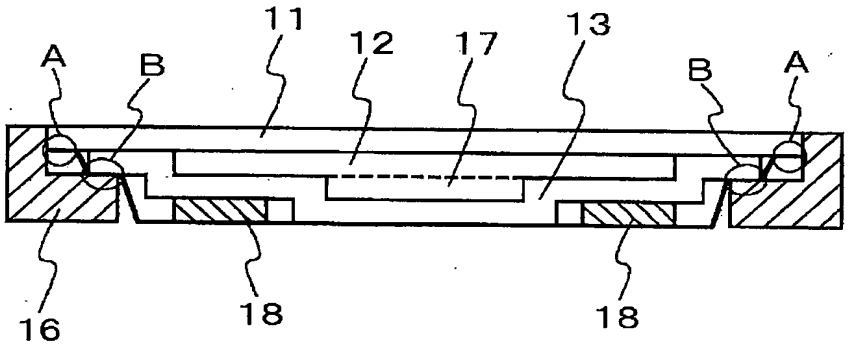
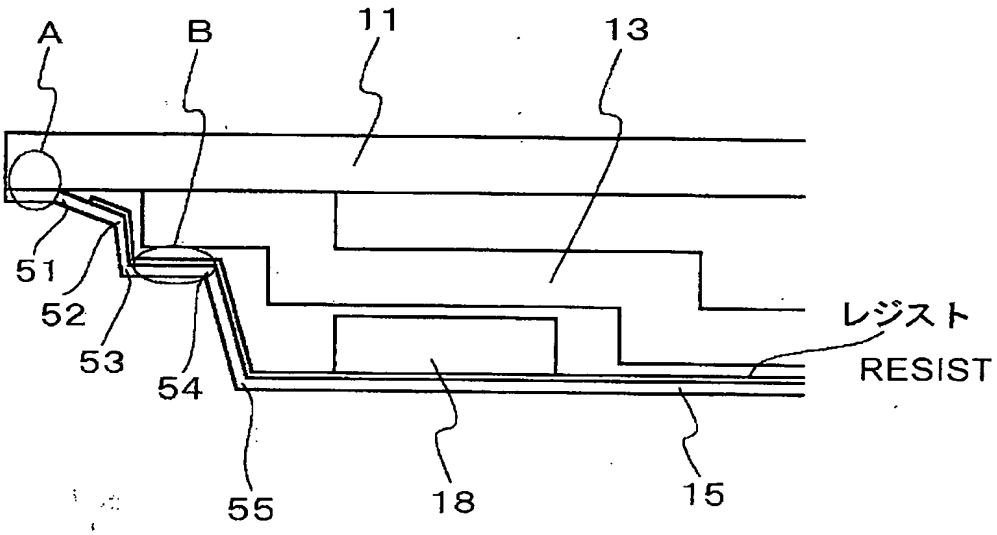
【図３】 [FIG.3]



【図４】 [FIG.4]



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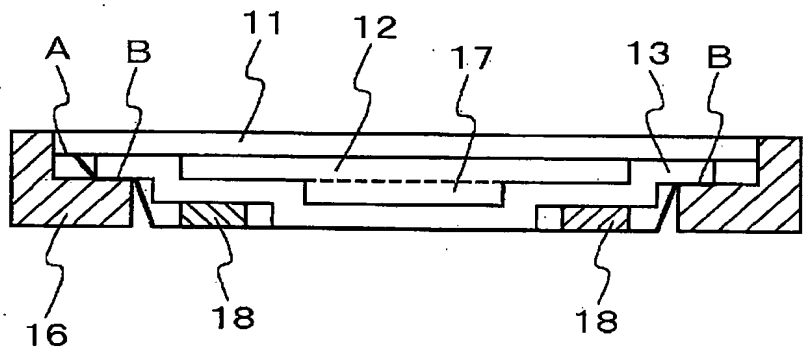
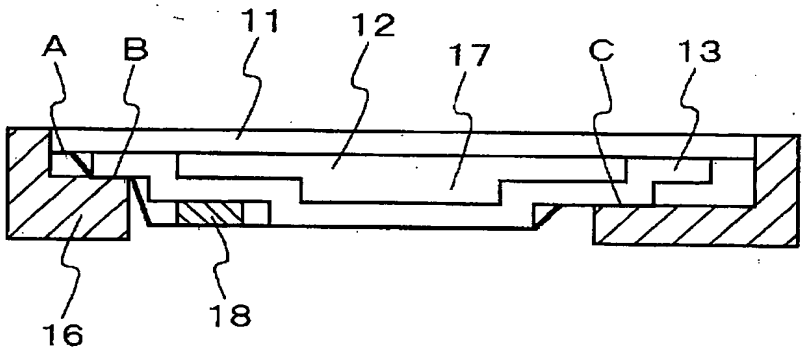
【図５】 [FIG.5]



【図６】 [FIG.6]



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【図７】 [FIG.7]